Permeable Reactive Barriers for In Situ Treatment of Chlorinated Solvents

A Collaborative, SERDP-supported Effort between the US AFRL/MLQ, the EPA NERL, and the Remediation Technologies Development Forum (RTDF) Permeable Barriers Action Team (PBAT)

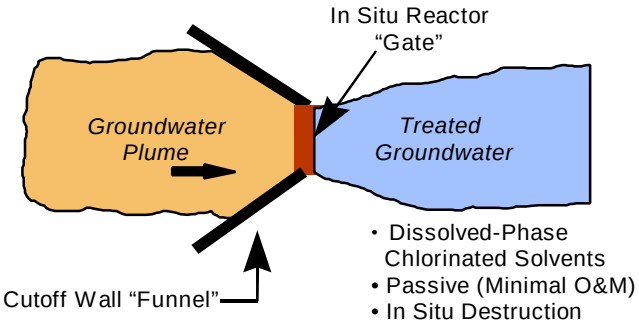
THE NEED

Chlorinated solvents have been used in massive quantities in the past. Their release into the environment accounts for a significant portion of environmental contamination. They have migrated through the subsurface and entered groundwater at more than 600 DOD sites, with a comparable degree of contamination at DOE and private Superfund sites.

CURRENT TECHNOLOGY:

Pump-and-treat (P&T) is used at over 90% of chlorinated solvent contaminated groundwater sites. P&T contains contaminant plumes and removes dissolved-phase contamination in relatively homogeneous geologic formations. Due to the slight solubility of the contaminant and its sorption to aquifer materials, P&T treats massive amounts of water but removes relatively little contamination. P&T, to fully remediate contaminated sites, may take decades to centuries. The high cost of P&T is due largely to O&M costs, including energy for pumping and water decontamination, materials for treatment, and labor.

AFRL/MLQ is investigating the permeable reactive barriers for in situ treatment of chlorinated solvent plumes. These direct contaminated groundwater, under passive flow, through an engineered subsurface region for decontamination. While this may not reduce the treatment duration, once installed, it will operate with little or no O&M investment. Expected savings throughout the life of the treatment are at least 50% over P&T. The use of this technology could result in total USAF savings of $25 million.

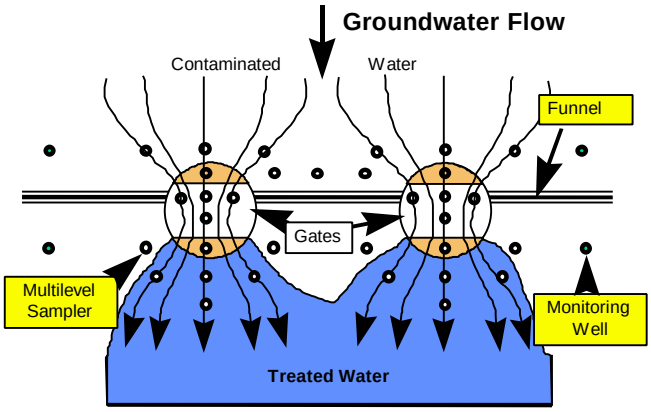


THE OBJECTIVES

This project tests alternative media at a field-scale demonstration for in situ permeable reactive barriers. Two reactive media are being tested to compare their dechlorination potentials. A permeable barrier design guidance document for in situ remediation of chlorinated solvents in groundwater was concurrently developed, field-tested, and reviewed by state and federal regulators. The design guidance addresses treatability testing, design, installation, and monitoring of barrier technologies in various geological settings. It includes input from the RTDF PBAT, including the USAF Center for Environmental Excellence, the Army Corps of Engineers, the Naval Facilities Engineering Service Center, industry, and other advisory groups of state and federal regulators.

THE EXPERIMENT

A rigorous pilot-scale field demonstration at Dover AFB, DE, is comparing the performance of two reactive media and involves innovative emplacement methods to reduce the construction costs of permeable barrier systems. The 40- to 45-foot deep barriers were constructed within a PCE-contaminated plume. One gate was filled with pure, zero-valent iron filings with a 10% iron/sand pretreatment zone before to stabilize flow and remove dissolved O_2. The second gate was also filled with iron but preceded by a 10% pyrite/sand mixture to moderate the pH of the reactive bed. Members of the RTDF investigated emplacement methods. Construction of the permeable barrier was completed during December 1997.



MONITORING

Several technical risks relate to the performance of the reactive media. Long-term performance of the reactive media under field conditions is unknown; the actual life of the barriers may not match the design life. This project will collect long-term data in a rigorous manner to determine life expectancies of the media. This will be compared to the small-scale (i.e., column) longevity tests to evaluate the reliability of the results obtained from the lab. Incomplete dechlorination may occur within the media. If the capacity of the media is reduced or the retention time within the media decreases over time, toxic intermediate byproducts of the dechlorination processes may exit the reactive media and move down gradient from the permeable barrier. Rigorous monitoring of the groundwater within and down gradient of the media will allow us to monitor for these intermediate compounds.

THE PLAYERS

The lead organization for this project is AFRL/MLQ. The main co-performer is the US EPA NERL. The project is funded primarily through SERDP. Other performers are Johns Hopkins University and Battelle.

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